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| EXAMINER |
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RADEMAKER, CLAIRE L

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| ART UNIT | PAPER NUMBER |
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1795

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10/19/2007

PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

## Office Action Summary

**Application No.**

10/520,326

**Applicant(s)**

MUELLEN ET AL.

**Examiner**

Claire L. Rademaker

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 12/28/2005; 1/5/2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 18-36 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 18-36 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)            | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)   | Paper No(s)/Mail Date. _____                                      |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>12/28/2005</u>  | 6) <input type="checkbox"/> Other: _____                          |

## **DETAILED ACTION**

### ***Information Disclosure Statement***

1. The listing of references in the specification is not a proper information disclosure statement. 37 CFR 1.98(b) requires a list of all patents, publications, or other information submitted for consideration by the Office, and MPEP § 609.04(a) states, "the list may not be incorporated into the specification but must be submitted in a separate paper." Therefore, unless the references have been cited by the examiner on form PTO-892, they have not been considered.

The following references have been mentioned in the specification, but have not listed in the IDS: Rikukawa et al. (*Prog. Polym. Sci.* 25, (2000) 1463-1502) (page 2, line 4); *J. Electrochem. Soc.*, vol. 142, No. 7, 1995, pp. L121-123 (page 1, lines 20-21); US Patents US 4,191,618, US 4,212,714, & US 4,333,805 (page 18, lines 8-9).

### ***Specification***

2. The disclosure is objected to because of the following informalities:
- i. The use of the phrase "Rikukawa et al." (page 2, line 11; page 4, line 8; page 21, line 5) is unclear because Rikukawa et al. was not previously disclosed using the name Rukukawa et al. For examination purposes, Rikukawa et al. was interpreted as referring to the article *Prog. Polym. Sci.* 25, (2000) 1463-1502 (page 2, line 4).

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- ii. The use of the trademark CELAZOLE (page 1, line 8) has been noted in this application. It should be capitalized wherever it appears and be accompanied by the generic terminology.

Although the use of trademarks is permissible in patent applications, the proprietary nature of the marks should be respected and every effort made to prevent their use in any manner which might adversely affect their validity as trademarks.

Appropriate correction is required.

### ***Claim Objections***

1. Claims 18-19, 25, and 28 are objected to because of the following informalities:
  - i. With regard to claims 18-19 and 25, the phrase "(1a) and/or (1b) and/or (1c) and/or (2)" (claim 18) is an improper form of a Markush group. In order to be written as a proper Markush group, the phrase should read "at least one recurring imidazole unit selected from (1a), (1b), (1c), or (2)" or "at least one recurring imidazole unit selected from the group consisting of (1a), (1b), (1c), and (2)." Furthermore, this format also applies to the phrases "(1a) and/or (1b) and/or (1c) and/or (2)" (claim 19), "(5) and/or (6)" (claim 25), and "(7), (8), (9), (10), and/or (11) (claim 25).
  - ii. Furthermore with regard to claim 25, the phrase "general formulae" (page 7, line 4) should be changed to "general formula" in order to remain

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consistent with the term "general formula" used throughout the other claims (claims 18-20) and the Specification.

iii. With regard to claim 28, the phrase "general formulae" (page 8, line 4) should be changed to "general formula" in order to remain consistent with the term "general formula" used throughout the other claims (claims 18-20) and the Specification.

Appropriate corrections are required.

3. Claim 20 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim (claim 18).

Applicant is required to cancel the claims, or amend the claims to place the claims in proper dependent form, or rewrite the claims in independent form.

The polyazole of formula 5a (claim 20) does not meet any of the general formulas of claim 18 (1a, 1b, 1c, or 2). In order for the polyazole of formula 5a to meet a general formula of claim 1, one or more  $-Y-Z_v$  functional groups (of claim 18) would need to replace one or both of the  $-H_s$  shown in 5a (claim 20).

### ***Claim Rejections - 35 USC § 112***

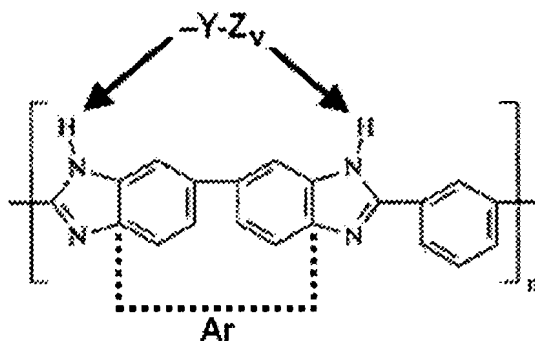
4. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

5. Claim 20 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

With regard to claim 20, the polyazole of formula 5a (claim 20) does not meet any of the general formulas of claim 18 (1a, 1b, 1c, or 2). In order for the benzimidazole unit of formula 5a to meet one of the functionalized polyazole formulas of claim 1, one or two  $-Y-Z_v$  functional groups (of claim 18) would need to replace one or both of the  $-H$ s shown in 5a (claim 20). For examination purposes, the benzimidazole unit of formula 5a was interpreted as meaning to contain one or two  $-Y-Z_v$  functional groups (of claim 18) and wherein Ar is represented by diphenyl.

The following image is supplied for clarification:



Furthermore, claim 20 recites the limitation "the polymer" in line 1. There is insufficient antecedent basis for this limitation in the claim. For examination purposes, "the polymer" of claim 20 was interpreted as meaning the functionalized polyazole of claim 18.

**Claim Rejections - 35 USC § 102**

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

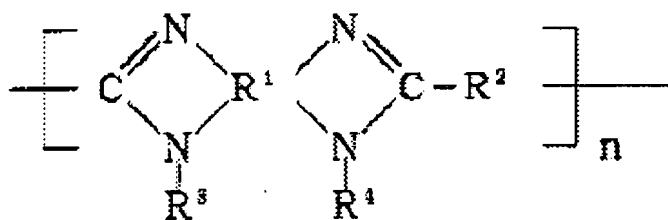
A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

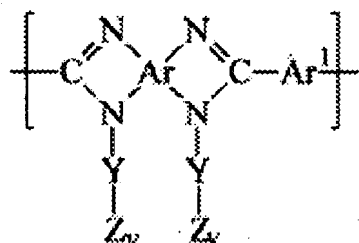
7. Claims 18-20 and 23-28 are rejected under 35 U.S.C. 102(b) as being anticipated by Bessho et al. (JP 09-110982).

With regard to claims 18-20 & 23-24, Bessho et al. discloses a functionalized polyazole comprising recurring imidazole units of following general formula:

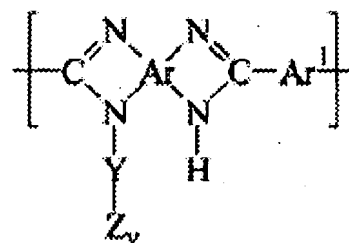
**Formula 1:**



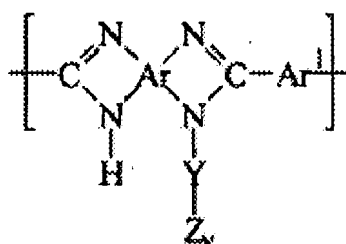
where R<sup>1</sup> is a tetravalent aromatic group, R<sup>2</sup> is a an aromatic or cyclic aliphatic group, R<sup>3</sup> and R<sup>4</sup> are, independently, a hydrogen atom, or an alkyl-phosphate group with 2-5 carbons, wherein each repeating imidazole unit can have a molar ratio of phosphorous to nitrogen (P/N) of 0.025-0.5 (paragraph [0008]), and where n is 10 (paragraph [0008]), which meets the following general formulas of the instant application:



(1a)

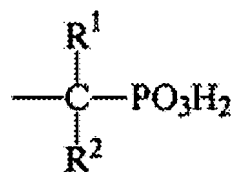


(1b)

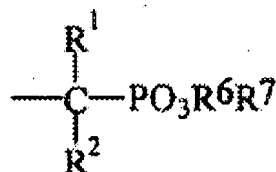


(1c)

where Ar is a tetravalent aromatic group, Ar<sup>1</sup> is a heteroaromatic group, Y is a bond or a group having from 2 to 5 carbon atoms, v is 10, and where Z is one of the following general formulas of the instant application:



(3)



(3')

where R<sup>1</sup> and R<sup>2</sup> are hydrogen atoms, wherein N,N-dimethylacetamide (DMAc) is used as a solvent (paragraphs [0018] & [0027]).

While Bessho et al. fails to disclose the specified solubility of the polyazazole of Formula 1 (see above) in DMAc, it is expected that the solubility of the polyazazole of



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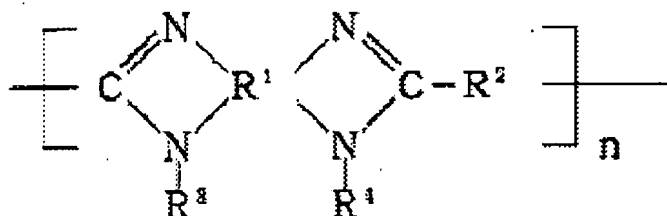
Formula 1 (see above) in DMAc of Bessho et al. would be comparable to that of the instant application, due to the specified polyazole and solvent compositions.

Furthermore, it is inherent that a polyazole that is materially the same as that of the instant application would have the same properties, such as the specified solubility parameters at a specified temperature.

With regard to claims 25-28, Bessho et al. discloses the process of preparing the functionalized polyazole of claim 19 comprising steps of:

(A) dissolving a polymer comprising recurring imidazole units of the following general formula:

**Formula 1:**

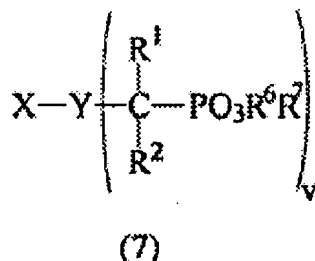


where  $R^1$  is a tetravalent aromatic group and  $R^2$  is a an aromatic or cyclic aliphatic group,  $R^3$  and  $R^4$  are hydrogen atoms, in a solvent to thereby form a first solution (paragraphs [0018] & [0027]), wherein each repeating imidazole unit can have a molar ratio of phosphorous to nitrogen (P/N) of 0.025-0.5 (paragraph [0008]), and where  $n$  is 10 (paragraph [0008]);

(B) Reacting the first solution with the base  $\text{CH}_3\text{O}^-$  to form a second solution (paragraph [0027]); and

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(C) Reacting the second solution with at least one phosphonate which meets the following general formula of the instant application:



where  $\text{R}^1$  and  $\text{R}^2$  are hydrogen atoms, X is a leaving group, Y is a bond or a group having from 2 to 5 carbon atoms, and v is 10 (paragraphs [0008], [0018], & [0027]), and wherein an acid is added to the solution (paragraph [0027]), but fails to specifically state the  $\text{pK}_b$  of the base  $\text{CH}_3\text{O}^-$  used in the reaction of claim 25.

While Bessho et al. fails to specifically state the  $\text{pK}_b$  at  $25^\circ\text{C}$  of  $\text{CH}_3\text{O}^-$ , it is expected that the  $\text{pK}_b$  at  $25^\circ\text{C}$  of the  $\text{CH}_3\text{O}^-$  of Bessho et al. would be comparable to that of the instant application, due to the specified base composition.

Furthermore, it is inherent that a base that is materially the same as that of the instant application would have the same properties at specified temperatures, such as specified  $\text{pK}_b$ .

### ***Claim Rejections - 35 USC § 103***

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

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invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 21-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bessho et al. (JP 09-110982) as applied to claim 19 above, and further in view of Savinell et al. (US 5,525,436).

The disclosure of Bessho et al. as discussed above is fully incorporated herein.

With regard to claims 21-22, Bessho et al. fails to teach the concept of doping or the specified degree of doping.

Savinell et al. teaches the concept of doping a polybenzimidazole membrane (col. 3, lines 31-32 & col. 6, lines 35-36), which can contain phosphonate groups (col. 6, lines 26-29), with a strong acid such as sulfuric or phosphoric acid (col. 6, lines 35-39) in order to enhance ionic conductivity (col. 6, lines 64-66), but fails to teach the specified degree of doping.

It would have been obvious to one of ordinary skill in the art at the time of the invention to add the concept of doping with a strong acid of Savinell et al. to the benzimidazole units of Bessho et al. in order to enhance ionic conductivity (col. 6, lines 64-66).

While Savinell et al. fails to teach the specified degree of doping, it would have been obvious to one of ordinary skill in the art at the time of the invention to adjust the degree of doping in order to obtain optimal results. It has been held that optimization of a result-effective variable, i.e. a variable which achieves a recognized result, is

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characterized as routine experimentation. *In re Boesch*, 617 F.2d, 272, 205 USPQ 215 (CCPA 1980).

10. Claims 29- 36 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bessho et al. (JP 09-110982) as applied to claims 18 and 26 above, further in view of Sakaguchi et al. (US 2004/0062969).

The disclosure of Bessho et al. as discussed above is fully incorporated herein.

With regard to claims 29-36, Bessho et al. teaches a polymer electrolyte membrane (PEM) (paragraphs [0023] & [0035]) comprising the polyazole of claim 18, which is obtainable by the process of claim 26, in a fuel cell (paragraph [0005]), but fails to teach the concept of coating a PEM with polyazoles, to specifically state that the fuel cell contains a MEA, or to specifically state that the polyazoles are ionomers.

Sakaguchi et al. teaches a fuel cell MEA (paragraph [00319]) containing a PEM (paragraph [0319]) coated with a polyazole polymer containing phosphonic acid groups (paragraphs [0221] & [0319]) in order to create a MEA with excellent mechanical properties and ion conductivity (paragraph [0319]).

It would have been obvious to one of ordinary skill in the art at the time of the invention to add the concept of coating of Sakaguchi et al. to the PEM of Bessho et al. in order to create a MEA with excellent mechanical properties and ion conductivity (paragraph [0319]).

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Furthermore, while Bessho et al. failed to specifically state that the fuel cell comprising the PEM contained a MEA, one of ordinary skill in the art would understand that it is inherent that a fuel cell comprising a PEM will contain a MEA because a fuel cell must contain electrodes in order to function.

Furthermore, while Bessho et al. fails to specifically state that the polyazoles are ionomers, the polyazoles of Bessho et al. would be comparable to the polyazoles of the instant application, due to the specified polyazole composition. It is inherent that a polyazole that is materially the same as that of the instant application would have the same charge as that of the polyazole of the instant application.

### ***Conclusion***


11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Claire L. Rademaker whose telephone number is 571-272-9809. The examiner can normally be reached on Monday - Friday, 8:00AM - 4:30PM, EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexa Neckel can be reached on 571-272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

CLR



ALEXA D. NECKEL  
SUPERVISORY PATENT EXAMINER